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1958 Agreement:
Consideration of draft amendments to existing UN Regulations submitted by GRB

Proposal for Supplement 4 to the 03 series of amendments to UN Regulation No. 51 (Noise of M and N categories of vehicles)

Submitted by the Working Party on Noise*

The text reproduced below was adopted by the Working Party on Noise (GRB) at its sixty-seventh session (ECE/TRANS/WP.29/GRB/65, paras. 8 and 11). It is based on Annexes II and III to the report. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee AC.1 for consideration at their June 2018 sessions.

* In accordance with the programme of work of the Inland Transport Committee for 2018–2019 (ECE/TRANS/274, para. 123 and ECE/TRANS/2018/21, Cluster 3.1), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

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Supplement 4 to the 03 series of amendments to UN Regulation No. 51 (Noise of M and N categories of vehicles)

Table of Contents, Annexes, add a new Annex 8:

"8 Indoor testing ..... "

Paragraph 6.2.1.1., amend to read:

"6.2.1.1. The sound made by the vehicle type submitted for approval shall be measured either indoors or outdoors by the methods described in Annex 3 to this Regulation. The specific conditions for indoor testing are provided in Annex 8 to this Regulation. The results of the outdoor and indoor tests are deemed equivalent.

For each specific test condition for vehicles, the manufacturer can select to test the vehicle either indoors or outdoors. The Type Approval Authority shall always have the option to mandate an outdoor test for verification. The option of the type approval authority to mandate an outdoor test shall apply to any test specified in this Regulation, including conformity of production testing.

In addition, the sound shall be measured on the stationary[3] vehicle; in the case of a vehicle where an internal combustion engine cannot operate when the vehicle is stationary, the emitted sound shall only be measured in motion. In the case of a hybrid electrical vehicle of category M_1 where an internal combustion engine cannot operate when the vehicle is stationary, the emitted sound shall be measured according to Annex 3, paragraph 4.

..."

Annex 1

Appendix 1, insert new items 2.4. and 2.4.1. to read:

"2.4. Testing method information

2.4.1. Test method selected: Outdoor/Indoor[1]"

Annex 3,

Paragraph 1., amend to read:

"1. Measuring instruments

1.1. Acoustic measurements

The apparatus used for measuring the sound level shall be a precision sound-level meter or equivalent measurement system meeting the requirements of Class 1 instruments (inclusive of the recommended windscreen, if used). These requirements are described in "IEC 61672- 1:2002: Precision sound level meters", second edition, of the International Electrotechnical Commission (IEC).

For indoor testing, when no general statement or conclusion can be made about conformance of the sound level meter by each channel of the array

[1] Delete what does not apply.

conformance (e.g. when pass-by sound level simulation algorithms do not compute the overall level but spectrum or temporal to recompose it), a simulated pass-by run shall be performed at a constant speed of 50 km/h while a constant tone signal is supplied to all channels of the arrays. The simulated A-weighted sound level is processed and the deviation from a reference tone signal shall be checked in accordance to IEC 61672-3.

..."

Paragraph 1.2., amend to read:

"1.2. Calibration of the entire Acoustic Measurement System for a Measurement Session

...

For indoor testing, the entire measurement system shall be checked at the beginning and at the end of a series of sessions.

A qualified calibration method (i.e. electrical calibration) is recommended to be provided by the hardware supplier and, in that case, shall be implemented in the measurement software used. Simulation algorithms using sound source localization detection should deactivate that feature for these tests."

Paragraph 2.1., amend to read:

"2.1. Test Site and ambient conditions

The specifications for the test site provide the necessary acoustic environment to carry out the vehicle tests documented in this Regulation. Outdoor and indoor test environments that meet the specifications of this Regulation provide equivalent acoustic environments and produce results that are equally valid.

2.1.1. Test Site Outdoor

The surface of the test track and the dimensions of the test site shall be in accordance with ISO 10844:2014.

2.1.2. Test Site Indoor

Test Site Indoor requirements shall be as specified below.

(a) The test room dimensions are described in paragraph 7.2. of ISO 362-3:2016. All room dimensions may be adjusted to meet the specific application for the products being tested according to Annex 8, paragraph 4.

(b) The test facility shall meet the requirements of ISO 26101:2012 with the qualification criteria and measurement requirements appropriate to this test method as described in ISO 362-3:2016, paragraph 7.3.

(c) Condition of the floor is described in ISO 362-3:2016, paragraph 7.4.

(d) Cooling, ventilation, and exhaust gas management are described in ISO 362-3:2016, paragraph 7.5.

(e) Dynamometer requirements are described in ISO 362-3:2016, paragraph 8.

(f) Vehicle fixing system is described in ISO 362-3:2016, paragraph 9.3.

2.1.3. Ambient conditions

The surface of the site shall be free of powdery snow, tall grass, loose soil or cinders. There shall be no obstacle which could affect the sound field within the vicinity of the microphone and the sound source. The observer carrying out the measurements shall so position themselves as not to affect the readings of the measuring instrument.

...

For indoor testing, background noise shall take into account noise emissions produced by the dynamometer rollers, ventilation systems, and facility exhaust gas systems."

Paragraph 2.2.1., amend to read:

"2.2.1. ...

Measurements shall be made on vehicles at the test mass m_t specified according to the following table.

When testing indoors, the test mass, m_t shall be utilized by the control system of the dyno roller. Actual mass of the vehicle has no effect on results and it is permitted to load the vehicle as necessary to prevent slip between the tyres and the dyno rolls. To detect excessive slip, it is recommended to control the ratio of engine rotational speed and vehicle speed between the acceleration phase and the constant-speed status. To avoid slip, it is possible to increase the axle load.

..."

Paragraph 2.2.2., amend to read:

"2.2.2. ...

When performing indoor testing, tyre/road sound is evaluated independently on the test track with the tyres to be used, according to this paragraph. Propulsion sound is independently evaluated on the dynamometer using tyres and other sound control measures to produce tyre/road sound which does not influence the measurement result."

Paragraph 3., amend to read:

"3. Methods of testing

Outdoor tests shall be performed according to paragraph 3.1.

Indoor tests shall be performed according to paragraph 3.1. using the specifications of ISO 362-3:2016, variant A. For indoor application, the manufacturer shall provide to the technical service, documentation according to Annex 8, paragraph 1. Variant A is a combination of indoor testing (power train sound) and outdoor testing (tyre/road sound).

..."

Paragraph 3.1.1., amend to read:

"3.1.1. General conditions of test

For outdoor testing, two lines, AA' and BB', parallel to line PP' and situated respectively 10 m ± 0.05 m forward and 10 m ± 0.05 m rearward of line PP' shall be marked out on the test runway.

For indoor testing, the virtual line AA' indicates the beginning of the test track, PP' indicates the virtual position of the two pass-by microphones, and

BB' indicates the end of the test track. The simulated vehicle speed at AA', $v_{AA'}$, or vehicle speed at PP', $v_{PP'}$, is defined by the roller speed when the reference point of the vehicle passes the virtual line AA' or PP', respectively. The simulated vehicle speed at BB', $v_{BB'}$, is defined when the rear of the vehicle passes the virtual line BB'.

..."

Paragraph 3.1.2.1.4.1., add a new subparagraph (e):

"3.1.2.1.4.1. Vehicles with manual transmission, automatic transmissions, adaptive transmissions or CVTs tested with locked gear ratios

...

(e) If no gear ratio is available with an acceleration below 2.0 m/s², the manufacturer shall, if possible take measures to avoid an acceleration value a_{wot} test greater than 2.0 m/s².

Table 1 in Appendix to Annex 3 provides examples for valid measures to control the downshift of gears or to avoid accelerations beyond 2.0 m/s². Any measure used by manufacturer for the above-mentioned purposes shall be documented in the test report."

Paragraph 3.1.2.1.4.2., amend to read:

"3.1.2.1.4.2. Vehicles with automatic transmission, adaptive transmissions and CVTs tested with non-locked gear ratios:

...

Therefore, it is permitted to establish and use electronic or mechanical devices, including alternate gear selector positions, to prevent a downshift to a gear ratio which is typically not used for the specified test condition in urban traffic.

If possible, the manufacturer shall take measures to avoid an acceleration value a_{wot} test greater than 2.0 m/s².

Table 1 in Appendix to Annex 3 provides examples for valid measures to control the downshift of gears or to avoid accelerations beyond 2.0 m/s². Any measure used by manufacturer for the above-mentioned purposes shall be documented in the test report.

..."

Paragraph 3.1.2.1.4.3., amend to read:

"3.1.2.1.4.3. Vehicles with only one gear ratio, like but not limited to Battery Electric Vehicles (BEV) and Fuel Cell Vehicles (FCV)

...

If possible, the manufacturer shall take measures to avoid an acceleration value $a_{wot\ test}$ greater than 2.0 m/s².

Table 1 in Appendix to Annex 3 provides examples for valid measures to avoid accelerations beyond 2.0 m/s². Any measure used by manufacturer for the above-mentioned purposes shall be documented in the test report.

..."

Paragraph 3.1.2.2.1.2., amend to read:

"3.1.2.2.1.2. Automatic transmission, adaptive transmissions, and transmissions with variable gear ratio tested with non-locked gear ratios

The gear selector position for full automatic operation shall be used.

The test may then include a gear change to a lower range and a higher acceleration. A gear change to a higher range and a lower acceleration is not allowed. In any case a gear change to a gear ratio that is typically not used at the specified condition as defined by the manufacturer in urban traffic shall be avoided.

Therefore, it is permitted to establish and use electronic or mechanical devices, including alternative gear selector positions, to prevent a downshift to a gear ratio that is typically not used at the specified test condition as defined by the manufacturer in urban traffic.

Table 1 in Appendix to Annex 3 provides examples for valid measures to control the downshift of gears. Any measure used by manufacturer for the above-mentioned purposes shall be documented in the test report.

..."

Paragraph 3.1.3., amend to read:

"3.1.3. Interpretation of results

For vehicles of categories M_1 and M_2 having a maximum authorized mass not exceeding 3,500 kg, and category N_1 the maximum A-weighted sound pressure level indicated during each passage of the vehicle between the two lines AA' and BB' shall be rounded to the first significant digit after the decimal place (e.g. XX,X).

For vehicles of category M_2 having a maximum authorized mass exceeding 3,500 kg and categories M_3, N_2, and N_3 the maximum A-weighted sound pressure level indicated during each passage of the reference point of the vehicle between line AA' and line BB' + 5 m shall be rounded, to the first significant digit after the decimal place (e.g. XX,X).

For indoor testing, pass-by sound is simulated by measurement of power train sound on the dynamometer and energetical addition of the tyre/road sound (measured separately on an outdoor test track) according to Annex 8, paragraph 2 of this Regulation.

..."

Appendix to Annex 3, at the end, add a new table 1:

"Table 1
Examples for Devices and Measures to Enable a Vehicle Tested within the Acceleration Boundaries

No.	*Impact*	*Sub No.*	*Measure*	*Additional Requirements*
1	Lock of a discrete gear ratio	1*	A discrete gear ratio can be locked by the driver	none
		2	A discrete gear ratio is available onboard, but is not available to the driver. Locking can be activated by the manufacturer with an onboard (hidden) function or with an external device	none
2	Controlled gear shift management: Applicable to transmissions which cannot be locked, or where no locked gear provides a valid test result	1*	Kickdown is deactivated	none
		2	Gear shift change(s) can happen during the test, gear shift is controlled by activation of an internal function or external device	Acceleration** shall be between a_{urban} and $a_{wot,ref}$, not exceeding 2.0 m/s².
3	Partial load driving****	1	Acceleration is limited by a mechanical device	Acceleration** shall be between a_{urban} and $a_{wot,ref}$, not exceeding 2.0 m/s².
		2	External Programming for partial load acceleration***)	
4	Mixed Solution (Mode): This measure will be a mix of the above solutions combined in a specific mode	1*	Mode is available onboard and can be selected by the driver	none
		2	Mode is available onboard and can only be activated by the manufacturer with a hidden function or an external device	none
		3	Mode is not available onboard, an external software overrides the internal software	Acceleration** shall be between a_{urban} and $a_{wot,ref}$, not exceeding 2.0 m/s².

* Comment: This is a standard situation, already covered by the Regulation text.

** Applicable to vehicles of category M_1, N_1 and $M_2 \leq 3{,}500$ kg.

*** Partial load shall be achieved by simulation of the travel restriction of the accelerator. It is not allowed to interfere with the engine control management.

**** Applicable only to Pure Electric Vehicle (PEV) as defined in the 07 series of amendments to UN Regulation No. 83, paragraph 2.30.

"

Annex 7

Paragraph 2.5.1., amend to read:

"2.5.1. ...

In case of non-locked transmission conditions, the test may include a gear ratio change to a lower range and a higher acceleration. A gear change to a higher range and a lower acceleration is not allowed.

If possible, the manufacturer shall take measures to avoid that a gearshift leads to a condition not in compliance with the boundary conditions. For that, it is permitted to establish and use electronic or mechanical devices, such as alternate gear selector positions. If no such measures can be applied, the rationale shall be provided and documented in the technical report.

Table 1 in Appendix to Annex 3 provides examples for valid measures to control the downshift of gears. Any measure used by manufacturer for the above-mentioned purposes shall be documented in the test report."

Insert a new Annex 8 to read:

"Annex 8

Indoor testing

1. Documentation for indoor application

Documentation shall include:

(a) Validation of facility, e.g. free field propagation, dyno and air handling background noise level, dyno dynamic performance, software.

(b) Procedures to be applied for indoor testing, e.g. dyno and software set-up, loading and tie-down, air-handling and vehicle's temperature management.

(c) Coast down and tyre sound level data used for calculation of dynamometer load coefficients and tyre sound data used for determination of final reported results.

(d) Test results on a representative selection of the manufacturer's production to demonstrate that indoor testing delivers comparable results as outdoor testing within acceptable accuracy.

2. Vehicle tested indoor using Variant A

Indoor pass-by test is simulated by measurement of power train sound on the dynamometer and energetical addition of the tyre/road sound (measured separately on an outdoor test track).

2.1. General

This method is a combination of indoor testing (power train sound) and outdoor testing (tyre/road sound). It is not necessary to repeat the measurement of the tyre/road sound every time a vehicle is tested. The data of several tyres can be stored in a database and a matching data set from the database can then be used for the test.

2.2. Power train sound

It shall be ensured that there is no remaining tyre/road sound affecting the measurements. In any case it shall be ensured that the remaining tyre/road sound shall be at least 10 dB below the maximum A-weighted sound pressure level produced by the vehicle under test. If this condition cannot be fulfilled, a correction shall be carried out. This correction procedure is described in ISO 362-3:2016 Annex B, paragraph B.6.

The vehicle shall be measured according to the operating condition specified in paragraphs 3.1.2.1. or 3.1.2.2. of Annex 3 of this Regulation.

2.3. Tyre/road sound

The measurements of the tyre/road sound shall be performed on a test track as described paragraph 2.1.1. of Annex 3 of this Regulation. The evaluation of tyre/road sound consists of two procedures, namely:

(a) Evaluation of free rolling sound;

(b) Evaluation of tyre/road sound including torque influence which can be derived from a) by a simplified method.

All conditions for evaluation of tyre/road sound shall be done according to paragraph 3. of this Annex.

2.4. Calculation of the total vehicle sound

The total vehicle sound is the energetical sum of tyre/road sound and power train sound. This calculation shall be carried out for each single run as describe in ISO 362-3.2016, paragraph 10.2.4.

3. Procedure for measurement, evaluation, and calculation of tyre/road sound when using variant A

All conditions for evaluation of tyre/road sound, free rolling sound, and torque influence are described in ISO 362-3:2016, Annex B.

4. Adjustment of room dimensions

To cater for the smaller size test rooms, the maximum levels shall be evaluated with caution though to avoid missing them according to ISO 362-3:2016, Annex E."